CLAIMS

What is claimed is:

Sub A1

1. A method of processing data representative of color information extracted from an array of pixels in an imaging array, the imaging array including a plurality of pixels which are responsive to photon energy in a distinct spectral region, each of the pixels being capable of outputting an intensity value which is representative of an intensity of photoexposure in the spectral region associated with the pixel over an exposure period, the method comprising:

identifying each pixel responsive to photoexposure in a first spectral region having an intensity value between a minimum intensity value and a maximum intensity value to provide a plurality of first pixels;

for each of the first pixels,

selecting at least one pixel associated with a second spectral region to determine at least one associated second pixel and selecting at least one pixel associated with a third spectral region to determine at least one associated third pixel; and

associating the intensity value of the associated second pixel and the intensity value of the associated third pixel with the intensity value of the first pixel to determine a matching set therewith, the matching set including an associated selected first pixel, the selected second pixel and the selected third pixel; and

determining a first gain coefficient for application to the intensity values of each of the pixels associated with the second spectral region based upon an

accumulation of the intensity values associated with the selected second pixels and determining a second gain coefficient for application to the intensity values of each of the pixels associated with the third spectral region based upon an accumulation of the intensity values associated with the selected third pixels.

2. The method of claim 1, wherein the step of associating the intensity value of the associated second pixel and the intensity value of the associated third pixel with the intensity value of the selected first pixel further includes:

determining whether the intensity value of the associated second pixel is within a first range of the intensity value of the selected first pixel; and

determining whether the intensity value of the associated third pixel is within a second range of the intensity value of the associated second pixel.

3. The method of claim 1, wherein the step of determining the first and second gain coefficients further includes:

determining the first gain coefficent as being proportional to an average intensity value of all of the selected second pixels divided by an average intensity value of each of the selected first pixels; and

determining the second gain coefficient as being proportional to an average intensity value of all of the selected third pixels divided by the average intensity value of each of the selected first pixels.

4. The method of claim 1, the method further including:

scaling each of the pixels associated with second spectral region by the first gain coefficient; and

scaling each of the pixels associated with the third spectral region by the second gain coefficient.

5. The method of claim 1, wherein each of the pixels is associated with a location on the imaging array, and wherein the selecting step further includes:

selecting the at least one second associated pixel as having the same location as the first pixel; and

selecting the at least one third associated pixel as having the same location as the first pixel.

6. The method of claim 1, wherein each of the pixels is associated with a location on the imaging array, and wherein the selecting step further includes:

selecting the at least one second associated pixel as having a first adjacent location to the location of the first pixel; and

selecting the at least one third associated pixel as having a second adjacent location to the location of the display.

7. The method of claim 6, the method further including:

scaling each of the pixels associated with second spectral region by the first gain coefficient to provide a first scaled intensity value;

scaling each of the pixels associated with the third spectral region by the second gain coefficient to provide a second scaled intensity value;

determining an intensity value of a pixel associated with the second spectral region at the location of the first pixel based upon the first scaled intensity value; and

determining an intensity value of a pixel associated with the third spectral region at the location of the first pixel based upon the second scaled intensity value.

8. In a camera, the camera having an imaging array, the imaging array including a plurality of pixels which are responsive to photon energy in a distinct spectral region, each of the pixels being capable of outputting an intensity value which is representative of an intensity of photoexposure in the spectral region associated with the pixel over an exposure period, a lens for focusing an image of an object onto the imaging array, and a processor, the improvement including:

logic for identifying all pixels responsive to photoexposure in a first spectral region having an intensity value between a minimum intensity value and a maximum intensity value to provide a plurality of first pixels;

logic for selecting for each of the first pixels at least one associated second pixel responsive to photoexposure in a second spectral region;

logic for selecting for each of the first pixels at least one associated third pixel responsive to photoexposure in a third spectral region; and

logic for associating the intensity value of the associated second pixel and the intensity value of the associated third pixel with the intensity value of the first pixel to determine a matching set therewith, the matching set including an associated selected first pixel, selected second pixel and selected third pixel; and

logic for determining a first gain coefficient for application to the intensity values of each of the pixels associated with the second spectral region based upon an accumulation of the intensity values associated with the selected second pixels and for determining a second gain coefficient for application to the intensity values of each of the pixels associated with the third spectral region based upon an accumulation of the intensity values associated with the selected third pixels.

9. A computer readable medium for use in conjunction with an imaging array, the imaging array having a plurality of pixels which are responsive to photon energy in a distinct spectral region, each of the pixels being capable of outputting an intensity value which is representative of an intensity of photoexposure in the spectral region associated with the pixel over an exposure period, the computer readable medium having computer readable instructions encoded thereon for performing the following:

identifying all pixels responsive to photoexposure in a first spectral region having an intensity value between a minimum intensity value and a maximum intensity value to provide a plurality of first pixels;

for each of the first pixels,

selecting at least one pixel responsive to photoexposure in a second spectral region, the second spectral region being distinct from the first spectral region, to determine at least one associated second pixel and selecting at least one pixel responsive to photoexposure in a third spectral region, the third spectral region being distinct from the first and second spectral regions, to determine at least one associated third pixel; and

associating the intensity value of the associated second pixel and the intensity value of the associated third pixel with the intensity value of the first pixel to determine a matching set therewith, the matching set including an associated selected first pixel, selected second pixel and selected third pixel; and

determining a first gain coefficient for application to the intensity values of each of the pixels associated with the second spectral region based upon an accumulation of the intensity values associated with the selected second pixels and determining a second gain coefficient for application to the intensity values of each of the pixels associated with the third spectral region based upon an accumulation of the intensity values associated with the selected third pixels.

10. An image processor for use in conjunction with an imaging array, the imaging array including a plurality of pixels which are responsive to photon energy in a distinct spectral region, each of the pixels being capable of outputting an intensity value which is representative of an intensity of photoexposure in the spectral region associated with the pixel over an exposure period, the image processor comprising:

logic for identifying all pixels responsive to photoexposure in a first spectral region having an intensity value between a minimum intensity value and a maximum intensity value to provide a plurality of first pixels;

logic for selecting for each of the first pixels at least one pixel associated responsive to photoexposure in a second spectral region distinct from the first spectral region;

logic for selecting for each of the first pixels at least one spatially pixel responsive to photoexposure in a third spectral region, the third spectral region being distinct from the first and second spectral regions, to determine at least one associated third pixel; and

logic for associating the intensity value of the associated second pixel and the intensity value of the associated third pixel with the intensity value of the first pixel to determine a matching set therewith, the matching set including an associated selected first pixel, selected second pixel and selected third pixel; and

logic for determining a first gain coefficient for application to the intensity values of each of the pixels associated with the second spectral region based upon an accumulation of the intensity values associated with the selected second pixels and for determining a second gain coefficient for application to the intensity values of each of the pixels associated with the third spectral region based upon an accumulation of the intensity values associated with the selected third pixels.

11. A method of processing data representative of a color image based upon color information extracted from pixels in an imaging array, the imaging array including a plurality of pixels, each of the plurality of pixels being responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period, the method comprising:

identifying white regions in the image based upon a dispersion of the intensities of photoexposure at a group of associated pixels in the imaging array, each of the associated pixels being responsive to photoexposure in a distinct one of the plurality spectral regions or color channels; and

determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image.

12. The method of claim 11, wherein the step of identifying the white regions in the image further comprises:

selecting a reference channel from among the plurality of color channels;

determining groups of associated pixels in the image, each of the groups including at least one reference channel pixel associated with the reference channel and at

least one non-reference channel pixel associated with a color channel distinct from the reference channel; and

for each group of associated pixels, comparing an intensity of photoexposure of the reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel.

13. The method of claim 12, wherein the step of identifying the white regions in the image further comprises:

associating first and second non-reference channel pixels with each group of associated pixels; and

for each group of associated pixels,

determining whether an intensity of photoexposure of the first non-reference channel pixel and an intensity of photoexposure of a second non-reference channel are within a predetermined range about the intensity of photoexposure of the reference channel pixel reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel; and

determining whether the difference between the intensities of photoexposure of the first and second non-reference channel pixels is less than a predetermined difference.

14. The method of claim 11, the method further including:

calculating intermediate gain coefficients based upon the accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image; and

selecting the gain coefficients to be applied to the intensities of photoexposure in the image from among a plurality of sets of gain coefficients stored in memory based upon a closeness of the intermediate gain coefficients to the selected set of gain coefficients.

15. In a camera, the camera having an imaging array, the imaging array including a plurality of pixels which are responsive to photon energy in a distinct spectral region, each of the pixels being capable of outputting an intensity value which is representative of an intensity of photoexposure in the spectral region associated with the pixel over an exposure period, a lens for focusing an image of an object onto the imaging array, and a processor, the improvement including:

logic for identifying white regions in the image based upon a dispersion of the intensities of photoexposure at associated pixels, each of the associated pixels being responsive to photoexposure in a distinct one of the plurality spectral regions or color channels; and

logic for determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels

based upon an accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image.

16. The camera of claim 15, wherein the logic for identifying the white regions in the image further comprises:

logic for selecting a reference channel from among the plurality of color channels;

logic for determining groups of associated pixels in the image, each of the groups including at least one reference channel pixel associated with the reference channel and at least one non-reference channel pixel associated with a color channel distinct from the reference channel; and

for each group of associated pixels, logic for comparing an intensity of photoexposure of the reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel.

17. The camera of claim 15, wherein the logic for identifying the white regions in the image further comprises:

logic for associating first and second non-reference channel pixels with each group of associated pixels; and

for each group of associated pixels,

logic for determining whether an intensity of photoexposure of the first non-reference channel pixel and an intensity of photoexposure of a second non-reference channel are within a predetermined range about the

intensity of photoexposure of the reference channel pixel reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel; and

logic for determining whether the difference between the intensities of photoexposure of the first and second non-reference channel pixels is less than a predetermined difference.

18. The camera of claim 15, the camera further comprising:

logic for calculating intermediate gain coefficients based upon the accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image; and

logic for selecting the gain coefficients to be applied to the intensities of photoexposure in the image from among a plurality of sets of gain coefficients stored in memory based upon a closeness of the intermediate gain coefficients to the selected set of gain coefficients.

19. A computer readable medium for use in conjunction with an imaging array for receiving an image of an object, the imaging array including a plurality of pixels which are responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period,

the computer readable medium having computer readable instructions encoded thereon for performing the following:

identifying white regions in the image based upon a dispersion of the intensities of photoexposure at associated pixels, each of the associated pixels being responsive to photoexposure in a distinct one of the plurality spectral regions or color channels; and

determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image.

20. The computer readable medium of claim 19, the computer readable medium further including computer readable instructions encoded thereon for:

selecting a reference channel from among the plurality of color channels;

determining groups of associated pixels in the image, each of the groups including at least one reference channel pixel associated with the reference channel and at least one non-reference channel pixel associated with a color channel distinct from the reference channel; and

for each group of associated pixels, comparing an intensity of photoexposure of the reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel.

21. The computer readable medium of claim 19, the computer readable medium further including computer readable instructions encoded thereon for:

associating first and second non-reference channel pixels with each group of associated pixels; and

for each group of associated pixels,

determining whether an intensity of photoexposure of the first non-reference channel pixel and an intensity of photoexposure of a second non-reference channel are within a predetermined range about the intensity of photoexposure of the reference channel pixel reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel; and

determining whether the difference between the intensities of photoexposure of the first and second non-reference channel pixels is less than a predetermined difference.

22. The computer readable medium of claim 19, the computer readable medium further including computer readable instructions encoded thereon for:

calculating intermediate gain coefficients based upon the accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image; and

selecting the gain coefficients to be applied to the intensities of photoexposure in the image from among a plurality of sets of gain coefficients

stored in memory based upon a closeness of the intermediate gain coefficients to the selected set of gain coefficients.

23. An image processor for use in conjunction with an imaging array, the imaging array including a plurality of pixels which are responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period, the image processor comprising:

logic for identifying white regions in the image based upon a dispersion of the intensities of photoexposure at associated pixels, each of the associated pixels being responsive to photoexposure in a distinct one of the plurality spectral regions or color channels; and

logic for determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image.

24. The image processor of claim 23, wherein the logic for identifying the white regions in the image further comprises:

logic for selecting a reference channel from among the plurality of color channels;

logic for determining groups of associated pixels in the image, each of the groups including at least one reference channel pixel associated with the reference channel and at least one non-reference channel pixel associated with a color channel distinct from the reference channel; and

for each group of associated pixels, logic for comparing an intensity of photoexposure of the reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel.

25. The image processor of claim 23, wherein the logic for identifying the white regions in the image further comprises:

logic for associating first and second non-reference channel pixels with each group of associated pixels; and

for each group of associated pixels,

logic for determining whether an intensity of photoexposure of the first non-reference channel pixel and an intensity of photoexposure of a second non-reference channel are within a predetermined range about the intensity of photoexposure of the reference channel pixel reference channel pixel with an intensity of photoexposure of the at least one non-reference channel pixel; and

logic for determining whether the difference between the intensities of photoexposure of the first and second non-reference channel pixels is less than a predetermined difference.

26. The image processor of claim 23, the image processor further including:

logic for calculating intermediate gain coefficients based upon the accumulation of the intensities of photoexposure of the pixels associated with the at least one color channel in the white regions of the image; and

logic for selecting the gain coefficients to be applied to the intensities of photoexposure in the image from among a plurality of sets of gain coefficients stored in memory based upon a closeness of the intermediate gain coefficients to the selected set of gain coefficients.

27. A method of processing data representative of a color image based upon color information extracted from pixels in an imaging array, the imaging array including a plurality of pixels, each of the plurality of pixels being responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period, the method comprising:

associating a group of pixels in the array, the group of pixels including at least one pixel associated with each of the plurality of color channels;

for each of the pixels in the associated group of pixels, determining an associated whiteness weight based upon a dispersion among the intensities of photoexposure at pixels in the group associated with distinct ones of the color channels; and

determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an

accumulation of the intensities of photoexposure of each of the pixels of the color channel weighted by the whiteness weight associated with the pixel.

28. The method of claim 27, the method further including determining an associated whiteness weight using fuzzy logic.

29. The method of claim 27, the method further including determining a gain coefficient to be applied to the pixel intensity values of one of the color channels based upon an accumulation of at least some of the pixel intensity values of the color channel weighted by corresponding whiteness weights associated with the pixel intensity values of the color channel.

30. In a camera, the camera having an imaging array, the imaging array including a plurality of pixels, each of the plurality of pixels being responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period, the improvement including:

logic for associating a group of pixels in the array, the group of pixels including at least one pixel associated with each of the plurality of color channels;

for each of the pixels in the associated group of pixels, logic for determining an associated whiteness weight based upon a dispersion among the intensities of

photoexposure at pixels in the group associated with distinct ones of the color channels; and

logic for determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an accumulation of the intensities of photoexposure of each of the pixels of the color channel weighted by the whiteness weight associated with the pixel.

31. The camera of claim 30, the improvement further including logic for determining an associated whiteness weight using fuzzy logic.

32. The camera of claim 30, the improvement further including logic for determining a gain coefficient to be applied to the pixel intensity values of one of the color channels based upon an accumulation of at least some of the pixel intensity values of the color channel weighted by corresponding whiteness weights associated with the pixel intensity values of the color channel.

33. An image processor for use in conjunction with an imaging array, the imaging array including a plurality of pixels, each of the plurality of pixels being responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period, the image processor including:

logic for associating a group of pixels in the array, the group of pixels including at least one pixel associated with each of the plurality of color channels;

for each of the pixels in the associated group of pixels, logic for determining an associated whiteness weight based upon a dispersion among the intensities of photoexposure at pixels in the group associated with distinct ones of the color channels; and

logic for determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an accumulation of the intensities of photoexposure of each of the pixels of the color channel weighted by the whiteness weight associated with the pixel.

34. The image processor of claim 33, the image processor further including logic for determining an associated whiteness weight using fuzzy logic.

35. The image processor of claim 33, the image processor further including logic for determining a gain coefficient to be applied to the pixel intensity values of one of the color channels based upon an accumulation of at least some of the pixel intensity values of the color channel weighted by corresponding whiteness weights associated with the pixel intensity values of the color channel.

36. A computer readable medium for use in conjuction with processing data representative of a color image based upon color information extracted from pixels in an imaging array, the imaging array including a plurality of pixels, each of the plurality of

pixels being responsive to photon energy in one of a plurality of distinct spectral regions, each of the spectral regions being associated with one of a plurality of color channels, each of the pixels being capable of providing data representative of an intensity of photoexposure in the spectral region and color channel associated with the pixel over an exposure period, the computer readable medium having computer readable instructions encoded thereon for:

associating a group of pixels in the array, the group of pixels including at least one pixel associated with each of the plurality of color channels;

for each of the pixels in the associated group of pixels, determining an associated whiteness weight based upon a dispersion among the intensities of photoexposure at pixels in the group associated with distinct ones of the color channels; and

determining gain coefficients to be applied to intensities of photoexposure in the image for pixels associated with at least one of the color channels based upon an accumulation of the intensities of photoexposure of each of the pixels of the color channel weighted by the whiteness weight associated with the pixel.

37. The computer readable medium of claim 36, the computer readable medium further including computer readable instructions encoded thereon for determining an associated whiteness weight using fuzzy logic.

38. The computer readable medium of claim 36, the computer readable medium further including computer readable instructions encoded thereon for determining a gain coefficient to be applied to the pixel intensity values of one of the color channels based

upon an accumulation of at least some of the pixel intensity values of the color channel weighted by corresponding whiteness weights associated with the pixel intensity values of the color channel.

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